

13. The method of claim 12, wherein the parallel magnetic field is generated by a circular magnet array disposed within the sputtering chamber.

14. (Amended) The method of claim 13, wherein the chamber pressure is less than about 5 mTorr.

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15. (Amended) A method for depositing a magnetic film within a sputtering chamber containing a target and a substrate, comprising:
sputtering the target onto a surface of the substrate at a pressure less than about 15 mTorr;
collimating sputtering of the target with a grounded collimator disposed between the target and the substrate; and
providing a parallel magnetic field at the surface of the substrate during sputtering.

16. (Amended) The method of claim 15, wherein the sputtering occurs at a chamber pressure less than [15] about 5 mTorr.

17. (Amended) The method of claim 16, [further] wherein the parallel magnetic field is provided by a circular ring of magnets disposed within the chamber.

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18. (Amended) The method of claim 17, wherein the target and the surface of the substrate are maintained at a [long throw] distance of at least about 50 mm during sputtering.

19. The method of claim 18, wherein the target comprises a Ni/Fe alloy.

20. The method of claim 19, wherein the grounded collimator removes charges from target particles and reduces interference with the parallel magnetic field.

REMARKS

This is intended as a full and complete response to the Office Action dated November 12, 1999, Claims 1-20 remain pending following entry of this amendment.

The specification stands objected to because, on page 2, line 29, the word "through" should read "throw". Applicant has amended the specification accordingly.

Claim 16 stands objected to under 37 CFR 1.75(c) as being in improper dependant form. Applicant has amended claim 16 to more clearly recite the invention. Applicant respectfully requests that the Examiner withdraw the objection and allow the claim.

Claim 17 stands objected to based on an informality. Applicant has amended the claim to more clearly recite the invention. Therefore, Applicant respectfully requests that the Examiner withdraw the objection and allow the claim.

Claim 1 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over *Tepman*, U.S. Patent No. 5,380,414 (hereinafter "*Tepman* '414") in view of either *Tepman*, U.S. Patent No. 5,527,438 (hereinafter, "*Tepman* '438") or *Katsuki et al.*, U.S. Patent No. 5,728,276 (hereinafter, "*Katsuki*"). The Examiner states that *Tepman* '414 teaches a sputtering chamber containing a target 2, a substrate 4, and a collimator 3 positioned between the target and the substrate. The Examiner states that the collimator 3 is presumed to be grounded due to being inherently supported by the chamber wall, or that the grounded collimator 3 would be an obvious configuration in view of *Tepman* '438, referenced in the Applicant's specification, or *Katsuki*. The Examiner cites *Katsuki* as evidence that collimators are conventionally grounded. In addition, the Examiner indicates that a magnet array 11 is disposed within the chamber at equidistant ends of the substrate, and that the magnetic field is therefore presumed to be substantially parallel.

Applicant respectfully traverses the rejection. *Tepman* '414 teaches a deposition chamber having a shield 6, a target 2, an acceptor 10, and, in one embodiment, a collimator 3 disposed therein. The acceptor 10 is positioned at the bottom of the chamber for supporting a wafer. The acceptor 10 is made out of a pasting material such as aluminum or titanium, which readily adheres to other deposition materials and which resists cracking and flaking. A pasting cycle is run periodically in the chamber to form a barrier of pasting material between layers of the target material that deposit on the interior of the shield 6 and on the collimator 3. During a pasting cycle, pasting material is obtained from the acceptor 10 and sputtered onto chamber components, including the shield 6 and the collimator 3. This is done to prevent a layer of target material that has deposited on the shield 6 or collimator 3 from becoming so thick that it cracks and flakes.

In *Tepman* '414, the magnetic field generated by a secondary magnetron is used during a pasting cycle to control the plasma. Magnetrons are typically used in sputter chambers to confine and control plasma in the vicinity of a target by generating curved magnetic field lines that intersect the target. Magnetrons are not used to create a parallel magnetic field at the surface of a substrate or substrate support. The magnetic field created by the secondary magnetron in *Tepman* '414 consists of curved field lines that intersect the plane of the acceptor, or substrate support, which is also a target of pasting material in *Tepman* '414. Thus, the magnetic field generated by the secondary magnetron is *not* substantially parallel at the surface of the substrate support.

2 In one embodiment, the apparatus disclosed in *Tepman* '414 includes a collimator 3. The collimator 3, however, is *not* inherently supported by the chamber wall. As illustrated and described in *Tepman* '414, the collimator 3 may be electrically floating, and is positioned inside a shield 6 positioned within the interior of the chamber. Thus, *Tepman* '414 does not teach, show, or suggest a grounded collimator.

3 *Tepman* '438, referenced in the Applicant's Specification, teaches a collimator or screening tube 12 for improving uniformity of films sputter-deposited on the base and side walls of holes or trenches in the surface of a semiconductor substrate. *Tepman* '438 does not teach, show, or suggest the use of a grounded collimator.

4 *Katsuki* teaches a sputtering apparatus having a collimator which is insulated from other equipment. The potential of the collimator is variably controllable by a DC power source. The invention in *Katsuki* is described as being preferably applied to magnetron-type sputtering treatment apparatus (Col. 2, lines 16-62). Magnetrons are typically used in sputter chambers to confine and control plasma in the vicinity of a target by generating curved magnetic field lines that intersect the target. Magnetrons are not used to create a parallel magnetic field at the surface of a substrate or substrate support. Thus, *Katsuki* does not teach, show, or suggest forming a substantially parallel magnetic field at the surface of a substrate or a substrate support.

5 None of *Tepman* '414, *Tepman* '438, or *Katsuki* relate to the use of a magnet or magnet array to form magnetic fields of a particular orientation at the surface of a substrate or substrate support. Thus, none of *Tepman* '414, *Tepman* '438, or *Katsuki* contain any suggestion of a sputtering chamber containing a grounded collimator and a magnet array disposed within the chamber to form a substantially parallel magnetic field at the surface of a substrate support.

Therefore, Applicant respectfully requests that the Examiner withdraw the rejection and allow the claim.

Claims 1-2 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Tepman* '414, in view of either *Tepman* '438 or *Katsuki*, and further in view of *Hsu*, U.S. Patent No. 5,589,039. The Examiner states that *Hsu* teaches a magnetic array 30 disposed within the chamber to form a parallel magnetic field at the substrate surface, and magnetic domains of a sputtered magnetic thin film aligned during deposition.

6 Applicant respectfully traverses the rejection. *Tepman* '414, *Tepman* '438, and *Katsuki* are discussed above. *Hsu* teaches a biasing magnet structure for producing a parallel magnetic field that extends parallel to a substrate on which a magnetic thin film is being or has been deposited. *Hsu* does not teach the use of the magnet structure with a grounded collimator to deposit a film of desired orientation.

Therefore, *Tepman* '414, *Tepman* '438, *Katsuki*, or *Hsu*, neither alone nor in combination, teach, show or suggest an apparatus for depositing a magnetic film comprising a grounded collimator positioned between a target and a substrate support and a magnet array disposed within the chamber to form a substantially parallel magnetic field at the surface of the substrate support. Therefore, Applicant respectfully requests that the Examiner withdraw the rejection and allow the claims.

Claims 3-5 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Tepman* '414, in view of either *Tepman* '438 or *Katsuki*, and further in view of *Hsu*, and further in view of *Boys et al.*, U.S. Patent No. 4,500,409 (hereinafter, "*Boys*") and Applicant's admitted prior art. The Examiner states that *Boys* teaches a long throw distance of 2.5 inches or 50 millimeters. The Examiner further states that circular magnet arrays are used to form a symmetrical magnetic field around a circular substrate, and further that *Hsu* teaches a circular target which is symmetrical with the substrate, and therefore the substrate is reasonably presumed to also comprise a circular shape. Further, the Examiner states that Figure 5 of *Hsu* illustrates a wafer which is circular in shape.

Applicant respectfully traverses the rejection. *Tepman* '414, *Tepman* '438, *Katsuki* and *Hsu* are discussed above. *Boys* teaches a magnetron sputter coating source wherein the magnetic field is provided by current flowing through an electromagnetic coil, allowing variance of the magnetic field in the vicinity of the target. *Boys* does not teach, show, or suggest forming a substantially parallel magnetic field at the surface of a substrate support.

Therefore, *Tepman* '414, *Tepman* '438, *Katsuki*, *Hsu*, or *Boys*, neither alone nor in combination, teach, show or suggest an apparatus for depositing a magnetic film having a grounded collimator and a magnet array disposed within the chamber to form a substantially parallel magnetic field at the surface of a substrate support. Additionally and independently, *Tepman* '414, *Tepman* '438, *Katsuki*, *Hsu*, or *Boys*, neither alone nor in combination, teach, show or suggest an apparatus for depositing a magnetic film having a grounded collimator and a magnet array disposed within the chamber to form a substantially parallel magnetic field at the surface of a substrate support wherein a target is separated from the substrate support by a distance of at least 50 millimeters. Therefore, Applicant respectfully requests that the Examiner withdraw the rejection and allow the claims.

Claim 6 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over *Hsu* in view of *Boys*. The Examiner states that *Hsu* teaches a long throw distance that appears to be at least 50 millimeters, or that this would be obvious.

Applicant respectfully traverses the rejection. *Hsu* and *Boys* are discussed above. *Hsu* does not recite the distance between the target and the substrate. In fact, *Hsu* does not address

problems associated with sputtering distance. In addition, as discussed above, *Boys* contains no suggestion of forming a parallel magnetic field at the surface of the substrate to provide orientation to the deposited material. Therefore, neither *Hsu* nor *Boys*, alone nor in combination, teach, show or suggest the invention as claimed. Therefore, Applicant respectfully requests that the Examiner withdraw the rejection and allow the claim.

Claims 7-8 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Hsu* in view of *Boys*, and further in view of *Alex*, U.S. Patent No. 5,616,218 and either *Tepman* '438 or *Katsuki*. The Examiner states that *Alex* teaches a collimator 46 positioned between the target 43 and a substrate 49.

Applicant respectfully traverses the rejection. *Hsu*, *Boys*, *Tepman* '438 and *Katsuki* are discussed above. *Alex* teaches a method for selectively choosing the magnetic properties of a sputter deposited recording layer of magnetic recording medium comprising selectively collimating a metal underlayer sputter deposited onto a substrate and then sputter depositing a magnetic metal film upon the underlayer to form a magnetic recording layer. *Alex* does not teach a grounded collimator, nor even recite the manner in which the collimator is supported. In addition, *Alex* does not teach, show, or suggest forming a substantially parallel magnetic field at the surface of a substrate support, nor even relate to the use of a magnet or magnet array in forming magnetic fields of a particular orientation.

Therefore, *Hsu*, *Boys*, *Alex*, *Tepman* '438, or *Katsuki*, neither alone nor in combination, teach, show, or suggest an apparatus for depositing a magnetic film, comprising a sputtering chamber containing a target and a substrate support separated by a distance of at least 50 millimeters and a magnet array disposed within the chamber to form a parallel magnetic field at the surface of the substrate support. Therefore, Applicant believes the rejection has been obviated and requests allowance of the claims.

Claim 9 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over *Hsu* in view of *Boys*. The Examiner states that *Boys* teaches a chamber pressure of 4 mTorr and a long throw distance of 2.5 inches or 63 millimeters.

Applicant respectfully traverses the rejection. *Hsu* and *Boys* are discussed above. Neither *Hsu* nor *Boys* contain any suggestion of sputtering a target using a distance of at least 50 millimeters between the target and a substrate in combination with a substantially parallel magnetic field disposed at the surface of the substrate. Therefore, Applicant respectfully requests that the Examiner withdraw the rejection and allow the claim.

Claims 10-14 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Hsu* in view of *Boys*, and further in view of *Alex*, Applicant's admitted prior art, and either *Tepman* '438

or *Katsuki*. The Examiner cites *Alex, Tepman '438*, and *Katsuki* in relation to collimated sputtering of a target with a grounded collimator disposed between the target and the substrate.

Applicant respectfully traverses the rejection. *Hsu, Boys, Alex, Tepman '438*, and *Katsuki* are discussed above. Claims 10-14 contain all the limitations of claim 9, and are therefore patentable over *Hsu* and *Boys* for the reasons discussed above. In addition, none of *Alex, Tepman '438*, or *Katsuki* contain any suggestion of using a grounded collimator in combination with providing a magnetic field that is substantially parallel at the surface of a substrate. Therefore, *Hsu, Boys, Alex, Tepman '438*, or *Katsuki*, neither alone nor in combination, teach, show or suggest a method for depositing a magnetic film within a sputtering chamber, comprising sputtering the target at a chamber pressure less than 15 mTorr and maintaining a distance of at least 50 millimeters between the target and a substrate, within a magnetic field that is substantially parallel at the surface of the substrate. Additionally and independently, *Hsu, Boys, Alex, Tepman '438*, or *Katsuki*, neither alone nor in combination, teach, show or suggest a method for depositing a magnetic film within a sputtering chamber, comprising sputtering the target at a chamber pressure less than 15 mTorr and maintaining a distance of at least 50 millimeters between the target and a substrate, within a magnetic field that is substantially parallel at the surface of the substrate, and using a grounded collimator. Therefore, Applicant respectfully requests that the Examiner withdraw the rejection and allow the claims.

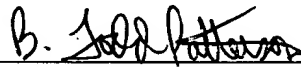
Claims 15-20 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Alex* in view of *Boys, Hsu*, Applicant's admitted prior art, and either *Tepman '438* or *Katsuki*.

Applicant respectfully traverses the rejection. None of the cited references contain any suggestion of sputtering a target at a pressure of less than about 15 mTorr or less than about 5 mTorr, in combination with providing a substantially parallel magnetic field at the surface of the substrate. Additionally, none of the cited references contain any suggestion of collimating sputtering with a grounded collimator in combination with providing a substantially parallel magnetic field at the surface of a substrate. Still further, none of the cited references contain any suggestion of sputtering a target at a distance of about 50 millimeters from a substrate or substrate supporting surface and providing a substantially parallel magnetic field at the surface of the substrate. Therefore, Applicant respectfully requests that the Examiner withdraw the rejection and allow the claims.

The prior art of record is noted. However, it is believed that the secondary references are no more pertinent to the Applicant's disclosure than the primary references cited in the Office Action. Therefore, it is believed that a detailed discussion of the secondary references is not necessary for a full and complete response to this Office Action.

In conclusion, the references cited by the Examiner, neither alone nor in combination, teach, show, or suggest the present invention. Therefore, it is believed that the rejections made by the Examiner have been obviated and the Applicant requests that the same be withdrawn. Allowance of claims 1-20 is respectfully requested.

Respectfully submitted,



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